50X1-HUM

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

50X1-HUM

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1-HUM

COUNTRY USSR

REPORT

SUBJECT Description and Operating Instructions for Soviet Air-Pressure Regulators Types RD-3, RD-4, RD-5, and RD-6

DATE DISTR. March 1964

NO. PAGES 1

REFERENCES

DATE OF INFO.

PLACE & DATE ACQ.

50X1-HUM

THIS IS UNEVALUATED INFORMATION. SOURCE GRADINGS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

50X1-HUM

1. a 17-page, English-language, Soviet manual entitled Air Pressure Regulators Types RD-3, RD-4, RD-5, and RD-6, Description and Operating Instructions, No publishing data appeared in the manual.

50X1-HUM

2. The RD-3, RD-4, RD-5, and RD-6 automatically regulate air pressure in the pressurized aircraft cabin, protecting it against pressures above the prescribed standard.

Distribution of Attachment for Retention:

OSI:
ORR:
Army:
Army/FSTC:
Navy:
Navy/STIC:
Air:
Air/FTD:
SAC:
NSA:

50X1-HUM

5 4 3 2 1

S-E-C-R-E-T
NO FOREIGN DISSEM

GROUP 1
Excluded from automatic downgrading and

50X1-HUM

STATE	DIA	ARMY	NAVY	AIR	NSA	XXX NIC		SAC
	Navy/STIC	ARMY/FSTC		AIR/FTD				

(Note: Field distribution indicated by "#".)

INFORMATION REPORT INFORMATION REPORT

50X1-HUM

AIR-PRESSURE REGULATORS TYPES RD–3, RD–4, RD–5, AND RD–6

DESCRIPTION AND OPERATING INSTRUCTIONS

(English Language)

Air-Pressure Regulators, Types РД-3, РД-4, РД-5, and РД-6

DESCRIPTION

AND

OPERATING INSTRUCTIONS

I. PURPOSE

Air-pressure regulators, types РД-3, РД-4, РД-5 and РД-6 (Figs 1 and 2), are designed for automatic regulation of air pressure in the pressurized cabin and for its protection against pressures above rated.

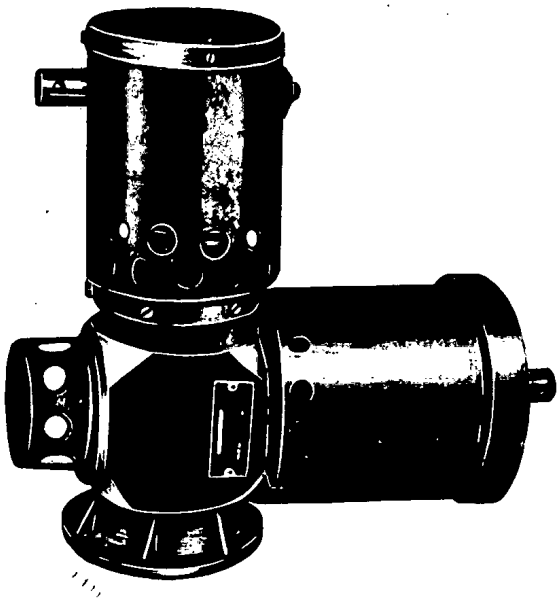

Fig. 1. Pressure Regulators, Types РД-3 and РД-5

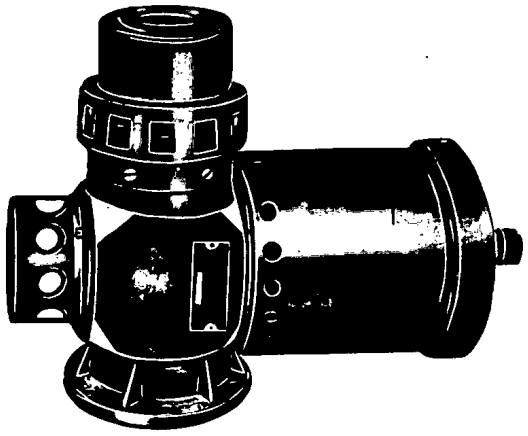

Fig. 2. Pressure Regulators, Types РД-4 and РД-6

II. BASIC SPECIFICATIONS

РД-3 and РД-4 Regulators

Excessive air pressure in cabin in relation to atmosphere at altitudes from 0 to 2,000 metres and air consumption of 50 kg/hr	Change in absolute pressure at altitude of 6,000 metres and air consumption from 20 to 160 kg/hr	Excessive air pressure at altitude of 10,000 metres and air consumption of 100 kg/hr	Change in excesive pressure at altitude of 10,000 metres and air consumption from 20 to 160 kg/hr	Air leakage with valves closed at altitude of 10,000 metres and cabin excessive air pressure of 236 mm of mercury
not exceeding 11 mm of mercury	not exceeding 25 mm of mercury	295 ± 9 mm of mercury	not exceeding 30 mm of mercury	not exceeding 22 lit./min.

РД-5 and РД-6 Regulators

Excessive air pressure in cabin in relation to atmosphere at altitudes from 0 to 2,000 metres and air consumption of 50 kg/hr	Change in absolute pressure at altitude of 6,000 metres and air consumption from 20 to 160 kg/hr	Excessive air pressure at altitude of 10,000 metres and air consumption from 20 to 160 kg/hr	Air leakage with valves closed at altitude of 8,500 metres and cabin excessive air pressure of 132 mm of mercury
not exceeding 11 mm of mercury	not exceeding 25 mm of mercury	220 $^{+8}_{-15}$ mm of mercury	not exceeding 3 lit./min.

The regulator functions properly at ambient air temperatures ranging from -60 to +50°C.

The РД-3, РД-4, РД-5, and РД-6 regulators are vibration-proof at a vibration overload of 2.5 g and a frequency of 50 c.p.s.

The РД-3 and РД-5 regulators weigh 1.75 kg; the РД-4 and РД-6 regulators - 1.45 kg.

III. PRINCIPLE OF OPERATION

The РД-3, РД-4, РД-5, and РД-6 regulators are of direct action.

Depending on the altitude of flight, operation of the regulator falls into the following three stages:

(a) first stage: ventilation of the cabin at altitudes up to 2,000 metres;

(b) second stage: gradual reduction of absolute pressure and increase of excessive pressure at altitudes up to 10,000 metres;

(c) third stage: maintenance of constant excessive pressure at altitudes above 10,000 metres.

The РД-3 and РД-5 regulators differ from the РД-4 and РД-6 regulators in the design of the return valve unit.

The РД-3, РД-4, РД-5, and РД-6 regulators at altitudes up to 6,000 metres have similar performance characteristics.

At altitudes above 6,000 metres the РД-3 regulator has performance characteristics similar to those of the

РД-4 regulator, and the РД-5 regulator - similar to those of the РД-6 regulator. However the characteristics of the РД-3 and РД-4 regulators differ at these altitudes from those of the РД-5 and РД-6 regulators.

The difference in characteristics between the regulator pairs (РД-3, РД-4, and РД-5, РД-6) at flight altitudes exceeding 6,000 m. depends on the sizes of the upper valves and the characteristics of the absolute pressure springs.

Relation between the altitude of flight and the pressure in the pressurized cabin for the РД-3 and РД-4 regulators is shown in Fig.3; the same relation for the РД-5 and РД-6 regulators is given in Fig.4.

The line AA_1 represents the theoretical curve of atmospheric pressure. Dotted lines show the permissible limits of regulation. AB section characterizes the first stage of operation, i.e. free ventilation of the cabin at altitudes up to 2,000 metres.

BC line refers to the second stage of operation, i.e. gradual reduction of the absolute pressure and increase of the cabin excessive pressure at altitudes up to 10,000 metres.

CD curve characterizes the regulator operation on the third stage, i.e. maintenance of constant excessive pressure at altitudes within 10,000 - 15,000 metres equal to $295^{\pm 9}$ mm of mercury for the РД-3 and РД-4 regulators and to 220^{+8}_{-25} mm of mercury for the РД-5 and РД-6 regulators, depending on air consumption.

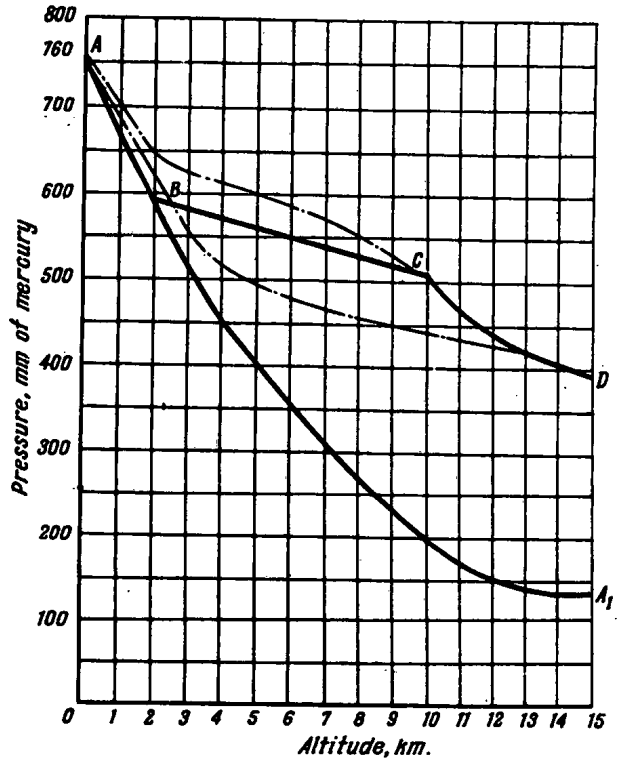

Fig. 3. Chart of Pressure Changes in Cabin Depending on Altitudes of Flight with РД-3 and РД-4 Regulators in Service

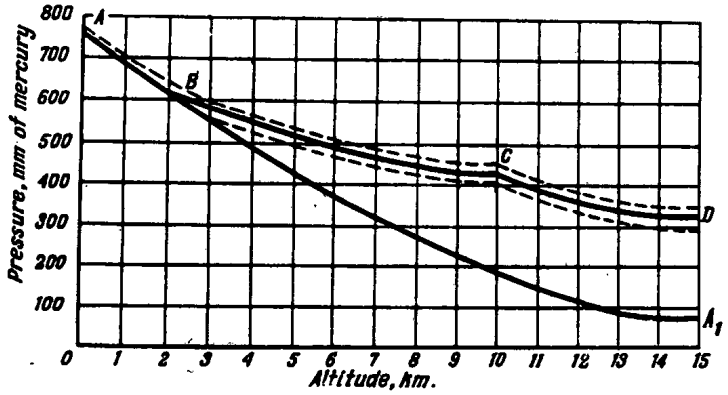

Fig. 4. Chart of Pressure Changes in Cabin Depending on Altitudes of Flight with РД-5 and РД-6 Regulators in Service

For proper operation of the regulator 20 to 160 kg/hr of air should be delivered into the cockpit in a constant and even flow.

Discharge of waste air from the cabin into the atmosphere is regulated by the position of double-unit valves 4 and 7 of different diameter in relation to valve seats 2 and 6 (Figs 5 and 6); the valves are actuated by sylphon 10 that regulates the absolute pressure in the cabin.

Spring 9, adjusted for a pre-set excessive pressure, provides for maintenance of constant excessive pressure by means of the same double-unit valves.

The valves are designed to maintain excessive pressure at an altitude exceeding 10,000 m, due to the change in initial compression of spring 9.

1. First stage of operation - cabin ventilation

With the aircraft ascending to an altitude of up to 2,000 metres the regulator provides for the ventilation of the cabin since the pressure in the cabin somewhat exceeds the outside pressure and the air passes from the cabin through the vents in cap 30 and sleeve 5 to valves 4 and 7, which rise from their seats 2 and 6 and let the air into the inner cavity of regulator housing 1. From the inner cavity of the housing the air escapes into the atmosphere.

Lift of valves 4 and 7 depends on the flight altitude and on the amount of excessive air pressure in the cabin as compared with the atmospheric pressure.

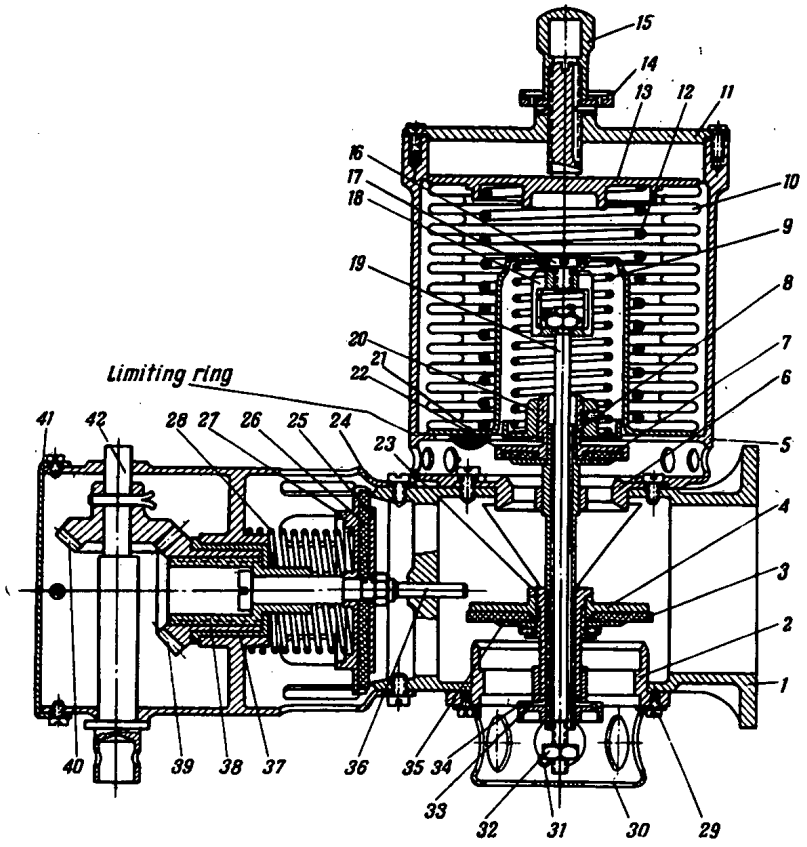

Fig. 5. Pressure Regulators, Types РД-3 and РД-5

1 — housing; 2 — bottom valve seat; 3 — rubber gasket; 4 — bottom valve; 5 — sleeve; 6 — top valve seat; 7 — top valve; 8 — rod; 9 — excessive pressure spring; 10 — sylphon; 11 — sleeve cover; 12 — sylphon spring; 13 — sylphon top cover; 14 — lock washer; 15 — blind nut; 16 — special screw; 17 — sylphon bottom cover; 18 — coupling sleeve; 19 — spindle; 20 — special nut; 21 — capillary tube; 22 — rubber gasket; 23 — bushing; 24 — non-return valve housing; 25 — special washer; 26 — rubber gasket; 27 — non-return valve; 28 — spring; 29 — screw; 30 — cap; 31 — cotter pin; 32 — nut; 33 — lock nut; 34 — lock washer; 35 — shaped nut; 36 — special screw; 37 — bushing; 38 — threaded bushing; 39 and 40 — gear wheels; 41 — non-return valve cover; 42 — shaft.

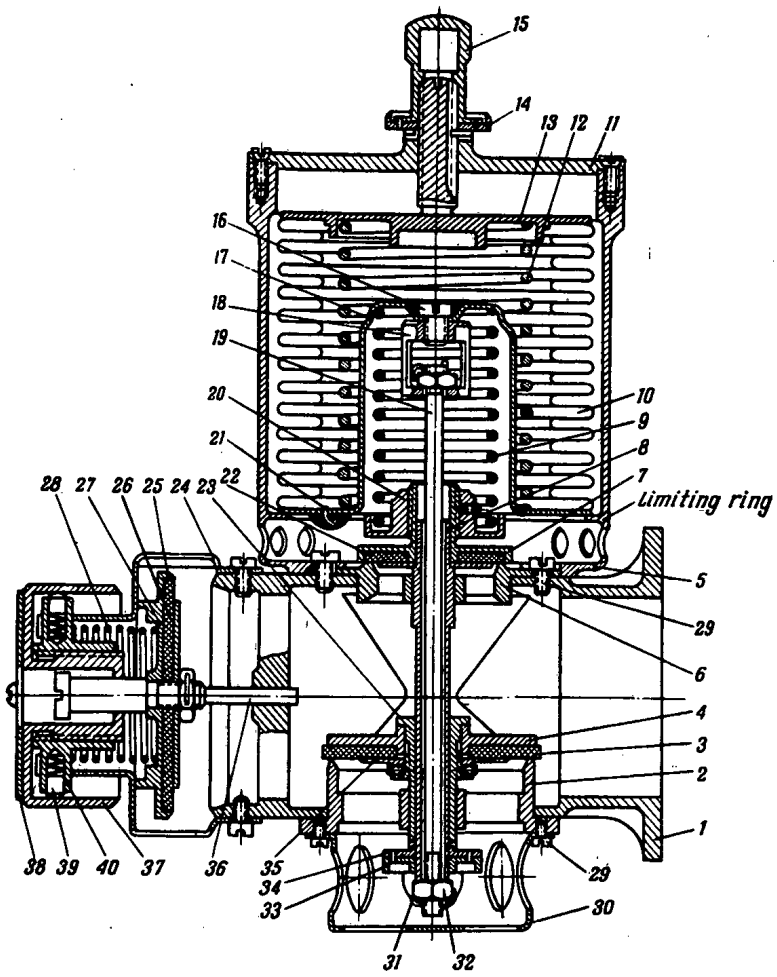

Fig. 6. Pressure Regulators, Types РД-4 and РД-6

1 — housing; 2 — bottom valve seat; 3 — rubber gasket; 4 — bottom valve; 5 — sleeve; 6 — top valve seat; 7 — top valve; 8 — rod; 9 — excessive pressure spring; 10 — syiphon; 11 — sleeve cover; 12 — syiphon spring; 13 — syiphon top cover; 14 — lock washer; 15 — blind nut; 16 — special screw; 17 — syiphon bottom cover; 18 — coupling sleeve; 19 — spindle; 20 — special nut; 21 — capillary tube; 22 — rubber gasket; 23 — bushing; 24 — non-return valve housing; 25 — special washer; 26 — rubber gasket; 27 — valve; 28 — spring; 29 — screw; 30 — cap; 31 — cotter pin; 32 — nut; 33 — lock nut; 34 — lock washer; 35 — shaped nut; 36 — special screw; 37 — handle; 38 — index plate; 39 — insert; 40 — spring.

Excessive pressure in the cabin is created by an air compressor and depends on the regulator hydraulic resistance; at air consumption of up to 50 kg/hr pressure in the cabin should not exceed 11 mm of mercury. At altitudes of up to 2,000 metres with an increase of air consumption to more than 50 kg/hr non-return valve 27 is resorted to.

2. Second stage of operation - regulation of absolute pressure in the cabin

At altitudes from 2,000 to 10,000 metres, sylphon 10 in which a preliminary vacuum has been created is compressed under the air pressure of the cabin and tension of spring 9.

Spring 9 and the air pressure are counter-balanced by the tension of spring 12 and resilience of the sylphon.

When the cabin air pressure reduces, spring 12 expands the sylphon, and valves 4 and 7 go down. The passages between the valves and their seats become smaller, thus reducing the amount of air discharged from the cabin into the atmosphere.

The pressure in the cabin will rise till it compresses the sylphon again and the valves connected with the sylphon by means of shaft 19 and nut 32 will go up. Then the pressure in the cabin begins to fall again till the sylphon expands and the valves go down.

3. Third stage of operation - maintenance of constant excessive air pressure

At an altitude of 10,000 metres the difference between the pressure in the cabin and the atmospheric pressure becomes 295 ± 9 mm of mercury for the РД-3 and РД-4 regulators and 220^{-8}_{+25} mm of mercury for the РД-5 and РД-6 regulators.

In this case the absolute pressure in the cabin is so low that spring 12 expands sylphon 10 till the latter rests against the stop ring of sleeve 5. At this moment valves 4 and 7 actuated by spring 9 sink into their seats 2 and 6 (Fig.7) thus stopping air release from the cabin into the air.

Thus, the РД-3 and РД-4 regulators maintain an excessive pressure of 295 ± 9 mm of mercury, while the РД-5 and РД-6 regulators maintain an excessive pressure of 220^{+8}_{-25} mm of mercury. The air pressure in the cabin is mainly received by valve 4, having a larger surface.

To ensure even operation of the regulator, valves 4 and 7 secured on rod 8 receive the cabin pressure from opposite sides. The main flow of air from the cabin passing through open valve 4 joins with a smaller air stream flowing from the opposite direction through open valve 7 (Fig.8).

4. Non-Return Valve Operation

(Figs 9 and 10)

Besides the double-unit valves, the regulator is provided with non-return valve 27 that operates when the pressure in the cabin becomes less than the outside air pressure.

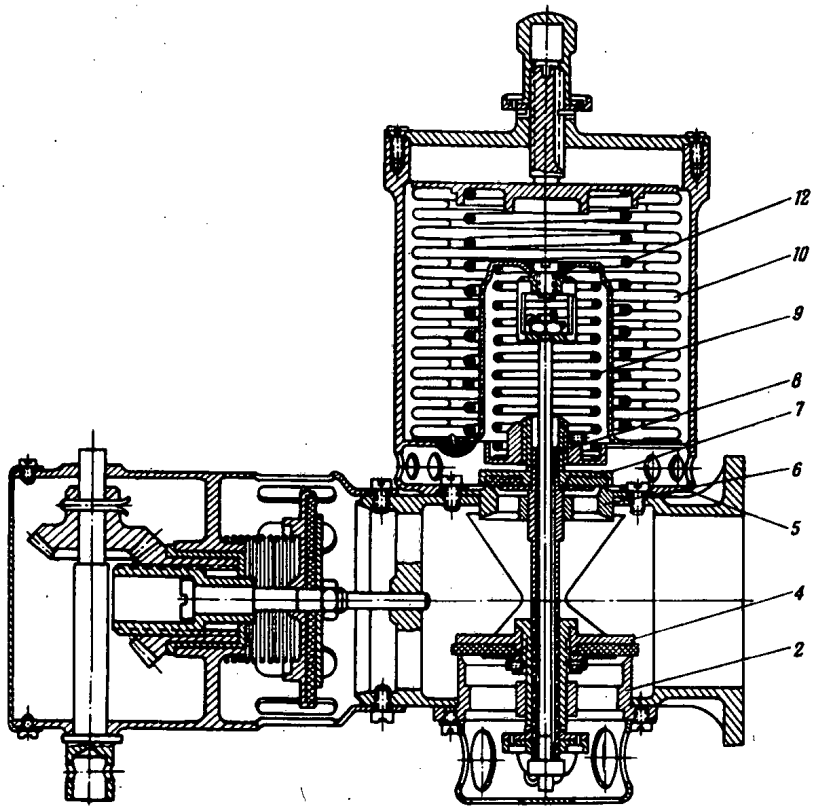

Fig. 7. Operation of РД-3 and РД-5 Regulators on Third Stage (with valves closed)

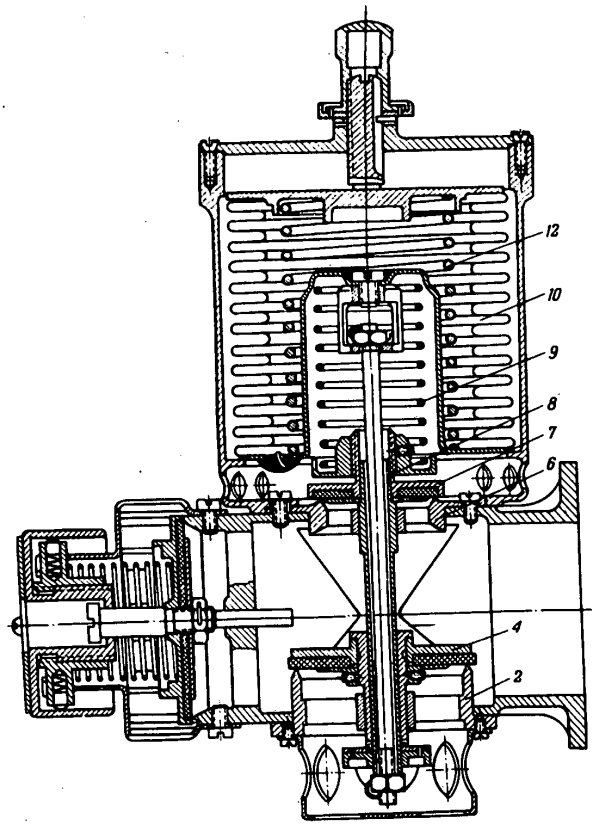

Fig. 8. Operation of РД-4 and РД-6 Regulators on Third Stage (with valves closed)

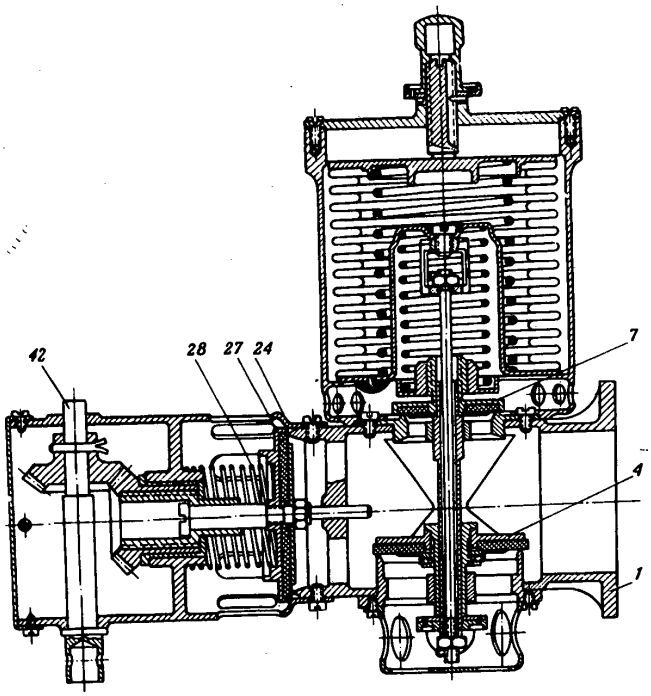

Fig. 9. Non-Return Valve of РД-3 and РД-5 Regulators

1 — housing; 4 — bottom valve; 7 — top valve; 24 — non-return valve housing; 27 — valve; 28 — spring; 42 — shaft.

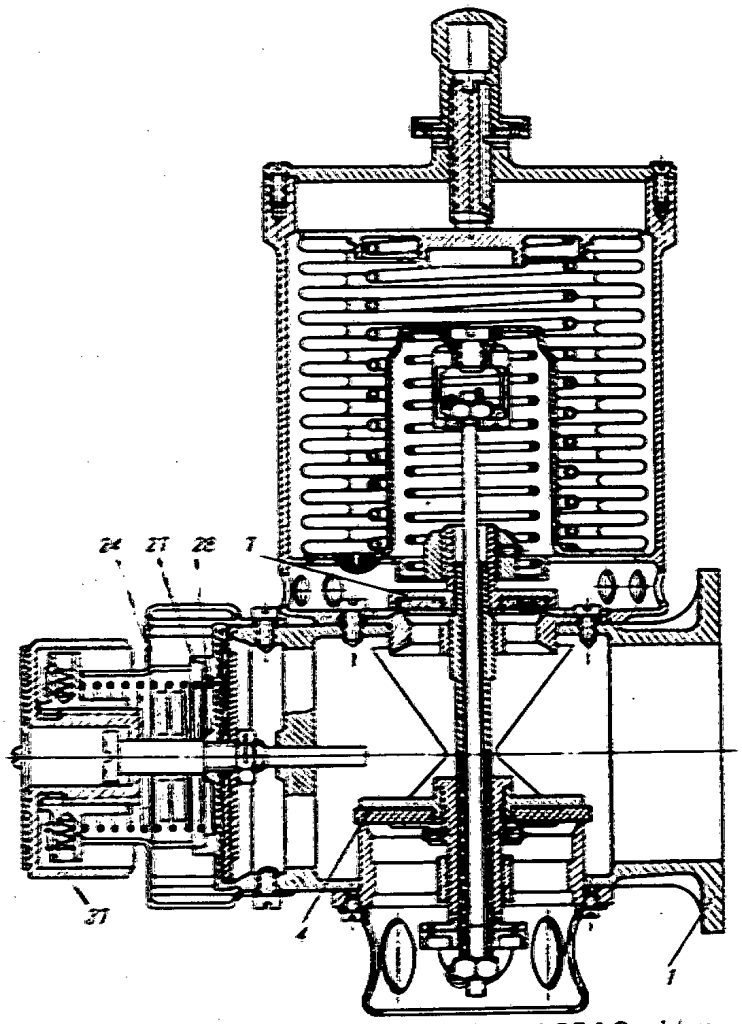

Fig. 10. Non-Return Valve of РД-4 and РД-6 Regulators

1 — housing; 4 — bottom valve; 7 — top valve; 24 — non-return valve housing; 27 — valve; 28 — spring; 27 — handle.

Low pressure may occur in the cabin during diving from a considerable altitude; if at this moment the superchargers are late to deliver the proper amount of air into the cabin, the atmospheric air passing into regulator housing 1 through the inlet and overcoming the resilience of spring 28 adjusted for a pressure drop of up to 15 mm of mercury, will balance the air pressure in the cabin with that outside the aircraft. At this moment valves 4 and 7 are closed.

In case the pressure in the cabin exceeds the rated value, valve 27 should be opened by means of handle 37 (Fig.10) or shaft 42 (See Fig.9), and the pressure in the cabin reduced.

IV. DESIGN

The regulator consists of the following main parts:

variable absolute pressure unit;

constant excessive pressure unit;

operating mechanism;

non-return valve with manual-operated regulator.

1. Variable Absolute Pressure Unit

The variable absolute pressure unit comprises sylphon 10 and expanding spring 12 mounted between covers 13 and 17 (Figs 5 and 6).

The sylphon is secured to sleeve cover 11 by means of the threaded lug of sylphon cover 13. The sylphon and expanding spring are adjusted to balance the outside air pressure up to the altitude of 2,000 metres.

Sylphon 10 is connected to valves 4 and 7 through spring 9 and rod 8. The sylphon is actuated by the cabin air pressure through the opening in sleeve 5. Cover 11 is secured to the sleeve by six screws. Four screws 29 fix sleeve 5 to housing 1.

2. Constant Excessive Pressure Unit

The constant excessive pressure unit comprises spring 9, compressed between cover 17 and thrust nut 20, a system of valves, and a slave mechanism.

3. Slave Mechanism

The slave mechanism consists of top small-size valve 7 and bottom large-size valve 4.

Valves 4 and 7 are mounted on rod 8. The valves are sealed by rubber gaskets 3 and 22 that are secured to the valves by means of nuts 35.

Bottom valve 4 is fixed to threaded bushing 23 with the help of nut 35 and stop screws. Bushing 23 together with valve 4 is screwed on rod 8.

Simultaneous sinking of valves 4 and 7 into seats 2 and 6, is adjusted by shifting valve 4 along rod 8. After the valves have been adjusted, the bottom valve is locked with nut 33 and lock washer 34.

A special shaped hole is made in lock washer 34 to turn rod 8, if necessary. The slave mechanism is secured to the sylphon unit with the help of spindle 19 and coupling sleeve 18.

4. Non-Return Valve with Manual-Operated Pressure Governor

The non-return valve with the manual-operated pressure governor comprises valve 27, rubber gasket 26 fixed to the valve and spring 28.

In case of necessity the non-return valve of the РД-3 and РД-5 regulators (See Fig.5), may be put into operation by the pilot who sets toothed bevel gears 39 and 40 to motion by rotating shaft 42. Threaded bushing 38 connected with the gears moves translationally and pulls screw 36; at this movement the non-return valve rigidly fixed to the screw rises from the seat of housing 1 and communicates the cabin air with the atmosphere.

In the РД-4 and РД-6 regulators (See Fig.6) the non-return valve is controlled by handle 37 which, when rotated, meshes with screw 36 and puts the non-return valve into operation. Four inserts 39 pressed to the inner wall of handle 37 by springs 40 are provided for self-stopping of the handle.

V. BRIEF INSTALLATION AND OPERATING INSTRUCTIONS

1. Installing the Regulator

The regulator is installed in the cabin so that the handle for manual pressure regulation is easily accessible. The regulator may be installed in any position on the cabin skin or on a spacial branch pipe, not less than 50 mm in diameter and 500 mm in length.

The outlet of the branch pipe should be located in the zone of aerodynamic pressure, almost equal to static pressure or a little higher than the latter (not exceeding 150 mm of water); its location in the zone of the negative pressure is not permissible, since in this case the vacuum in the cabin, with the non-return valve in operation, will increase respectively.

It is also recommended that the branch pipe outlet be accessible from the outside of the cabin for plugging it without dismounting the regulator during cabin pressure tests under airfield conditions. The regulator flange is sealed with a paronite gasket. Bolts, 5 mm in diameter, are used to fix the regulator to the cabin.

In case the regulator is fixed directly to the cabin skin, a rigid ring should be provided to convey an even pressure to the gasket and to ensure airtightness. No damage to the regulator during installation is permissible, and the regulator inside should be protected against dirt and foreign particles.

All installation and overall dimensions of the regulators are given in Figs 11 and 12.

2. Operating Instructions

The regulator operates automatically and requires no special servicing when installed on the aircraft.

In rare cases the sylphon may lose its vacuum.

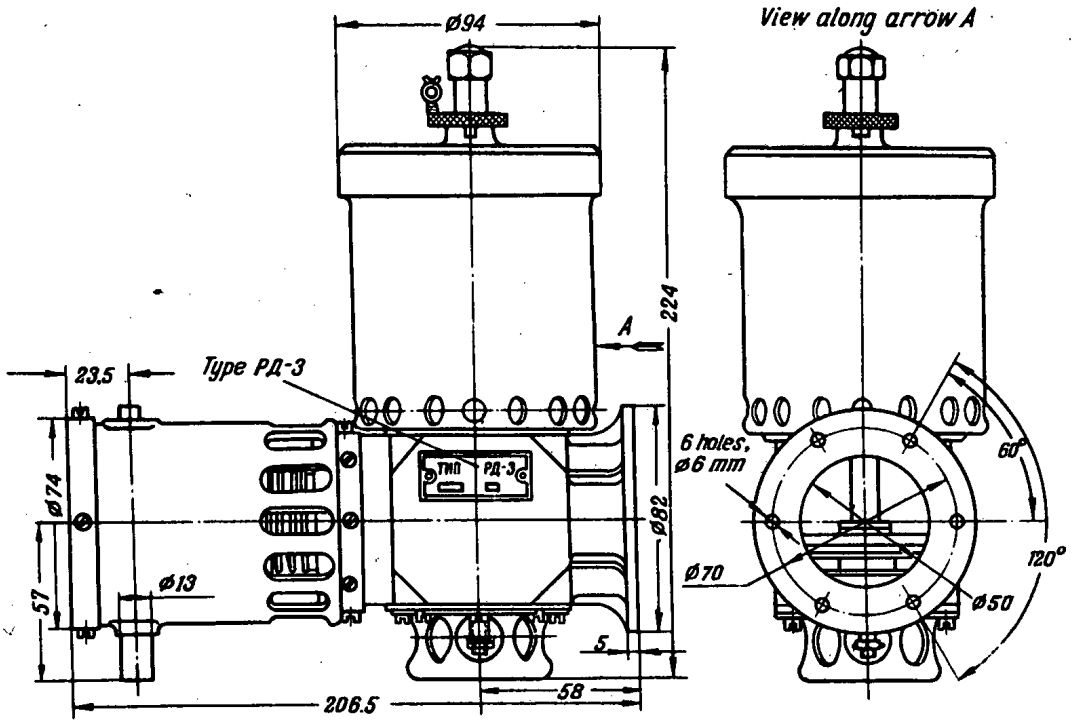

Fig. 11. Installation and Overall Dimensions of РД-3 and РД-5 Regulators

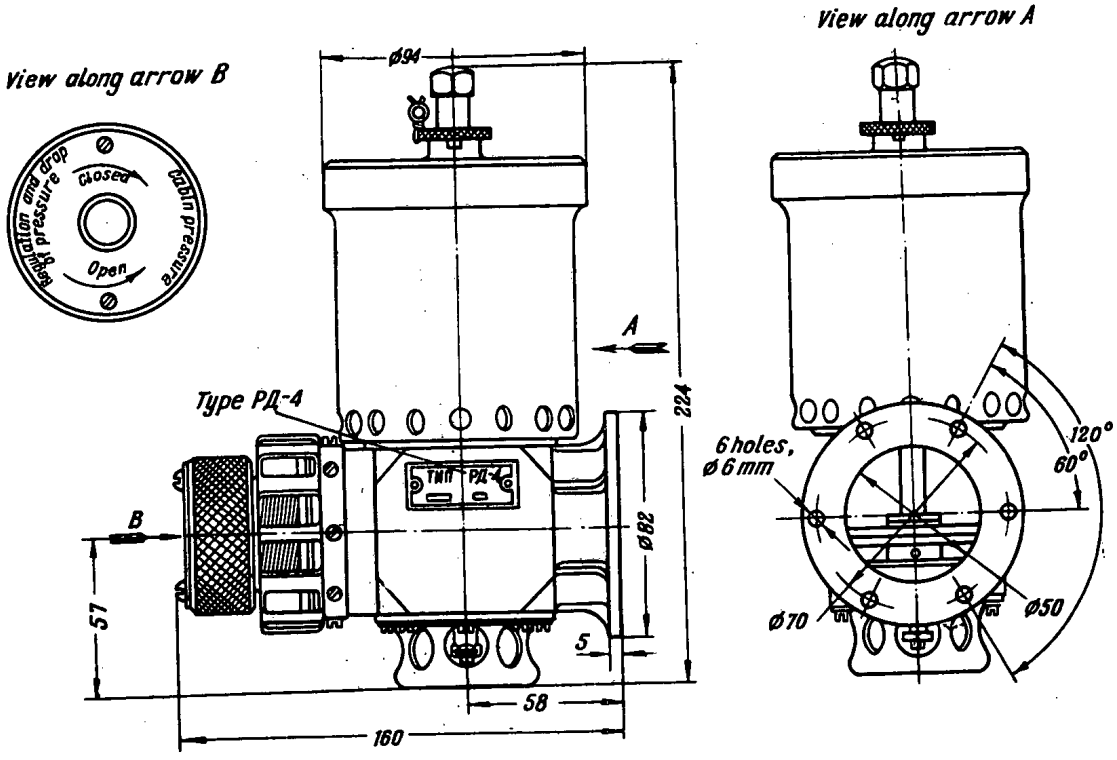

Fig. 12. Installation and Overall Dimensions of РД-4 and РД-6 Regulators

This involves creation of excessive pressure in the cabin at altitudes less than 2,000 metres. The regulator in which the sylphon has no vacuum is to be replaced with a new one. If a new regulator is not available, flights are permissible on condition that the air is supercharged and the pressure at low altitudes is regulated with the non-return valve handle.

3. Testing the Regulator

Prior to installation on the aircraft the regulator should be subjected to external inspection and testing.

No damage to the regulator is permissible. The sylphon should keep its vacuum. With the aircraft on the ground, bottom valve 4 of a regulator in good repair should be open (See Figs 5 and 6). Non-return valve 27 should open easily and tightly fit its seat.

The regulator should be checked for basic specifications (See Section II) on an installation as shown in the diagram (See Fig.13). The regulator to be tested is installed in pressure chamber 1 representing the cabin and secured to flange 3 of branch pipe 2. A paronite gasket should be inserted between the regulator and the flange to prevent air leakage.

The inner diameter of the branch pipe and flange should not be less than 50 mm.

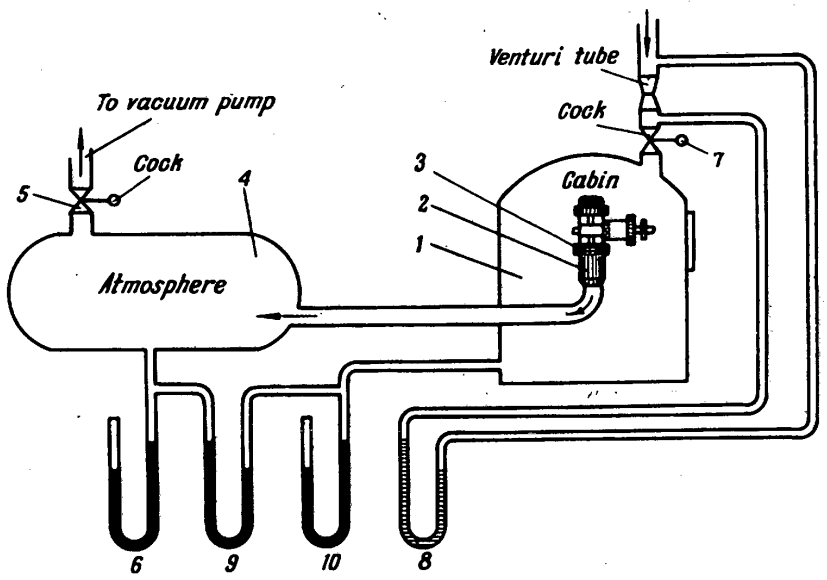

Fig. 13. Diagram of Regulator Testing Installation

1 — pressure chamber; 2 — branch pipe; 3 — flange; 4 — receiver; 5 — cock; 6 — barometer; 7 — valve; 8 — differential pressure gauge; 9 — differential pressure gauge; 10 — barometer.

Branch pipe 2 is connected to the receiver, representing the atmosphere. The air is sucked into the chamber due to the vacuum created there by the vacuum pump. Altitudes in the "atmosphere" are created by operating cock 5 according to barometer 6. Air consumption is regulated by means of cock 7 and measured with the help of a Venturi tube or diaphragm with differential pressure gauge 8. Excessive pressure between the "cabin" and "atmosphere" is measured with the help of differential pressure gauge 9.

4. Unpacking and Storage

On receiving boxes with regulators, make sure that the boxes are not damaged. If the boxes are damaged, draw up a reclamation paper to be sent to the transporting agency.

To unpack the regulators, proceed as follows:

(a) cautiously open the box by removing the cover with the inscription TOP (BEPX);

(b) take out the cardboard boxes with the regulators and open them. Take out the regulator Certificate and put it into the aircraft Service Log.

A regulator having no Certificate should not be installed on the aircraft;

(c) attentively inspect the regulator from the outside and make sure that the seals are not broken.

All faults detected during inspection are registered in an act drawn up on this occasion.

The regulators should be stored on racks in dry, well ventilated premises at a temperature from + 10 to +30°C and relative humidity from 30 to 80 per cent, under conditions excluding corrosion.

The regulator is kept in the Manufacturer's packing on wooden racks at a distance of 0.5 m. from the floor and walls.

Piling of regulators one on top of the other without packings is not permissible.

C O N T E N T S